
Space Weather Technical Forecast

Issued on Tuesday, 16 May 2023 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Slight Chance of R1/R2 radio blackouts throughout. Slight chance (10%) of a G1/Minor Geomagnetic Storm late Day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours with occasional C-class flares, the largest being a long duration C2.9 originating from AR3296 at 15/0810 UTC. This region has now crossed the western limb and is no longer visible. There are currently six sunspot regions on the visible disc. AR3305 remains the largest and most complex group. It has become slightly more elongated, with the addition of several little specs on its trailing portion and a change of magnetic configuration. The remaining areas are relatively small and simple with little sign of change or showing signs of decay. AR3296, AR3294 and AR3297 have all now rotated off the visible disc across the western limb.

A small filament lift-off was observed in the northwest quadrant early on the 15th, which produced a very faint, very slow CME. Another CME was observed in the southeast quadrant later in the UTC evening. The results of the analysis are still pending but no Earth-directed CMEs are expected at the time of writing.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was steady and slightly elevated, remaining between 440-500km/s. The solar wind density was very steady and at average levels. The interplanetary magnetic field (IMF) was also very steady and generally weak, with its north-south component (Bz) varying weakly between +/-5nT. The phi angle was mostly positive (away from the Sun) but seems to have become negative (towards the sun) since 15/2230UTC. The net result of the above solar wind measures was mostly Quiet (Kp0-2) to Unsettled (Kp3) geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, remained at Background level through the period. High energy electron flux (greater than 2MeV), as measured at GOES16, ranged from Moderate to Normal Background levels, with a peak of 131pfu observed at 15/2120UTC. The 24-hour integrated fluence has been well below Active levels and steadily declining. At 16/0001UTC, 2.91e6 integrated pfu was recorded.

Four-Day Space Weather Forecast Summary

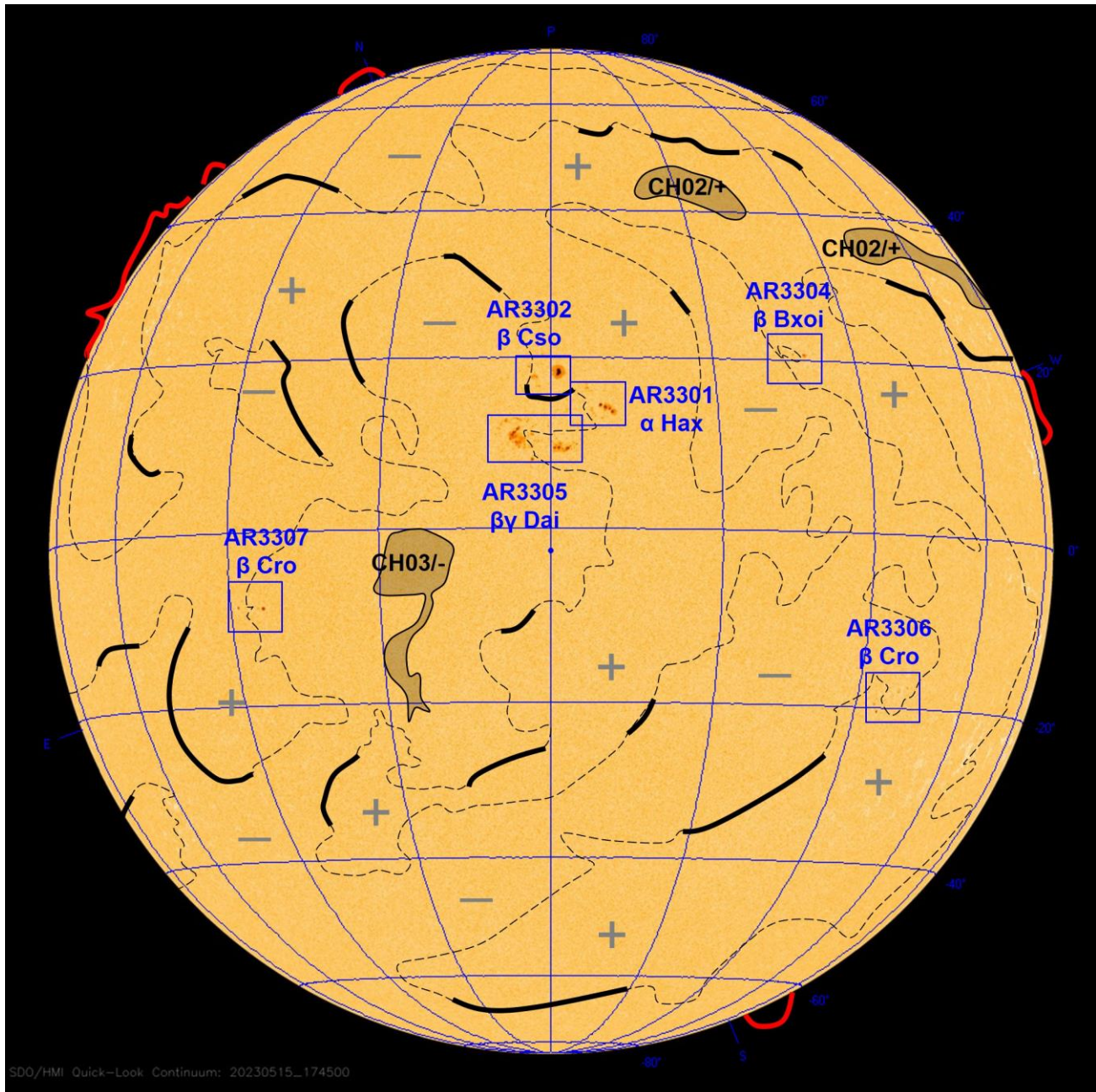
Solar Activity: Solar activity is expected to remain Low, but with a slight chance of isolated Moderate activity. The risk may increase over the following days as a returning region is about to emerge into the south-eastern quadrant.

Solar Wind / Geomagnetic Activity: Geomagnetic conditions are expected to remain largely Quiet to Unsettled. There is a slight chance of a glancing blow from CME events that left the Sun 11-13 May. This may produce minor effects at Earth and a slight chance of a G1/Minor Geomagnetic storm interval in the early UTC hours of the 16th but a miss is considered more likely. Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

likely, with no observable effects. Solar winds are expected to gradually decline towards background levels.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is most likely to persist at background levels through the period. High energy (greater than 2MeV) electron flux is expected to persist at Normal Background to Moderate levels. The associated 24-hour fluence is forecast to persist below the Active threshold.

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Up to three narrow glancing blows from CMEs feature in a minority of MOSWOC Enlil ensemble members from events that occurred 11-13 May. As a result, there is a slight chance that some effects may be observed at Earth early on Day 1 (16 May). However, the preferred solution is for the CMEs to pass above the ecliptic plane as shown in the main deterministic run.

Earth is currently in a slightly elevated solar wind regime following the impact of a CME on the 12th, with speeds of 440-480 km/s. With no significant coronal hole high speed stream on the western hemisphere and only the presence of a small high latitude coronal hole (CH02/+), solar wind speeds should initiate a slow decline towards background levels. MOSWOC Enlil is considered to be giving reasonably good guidance.

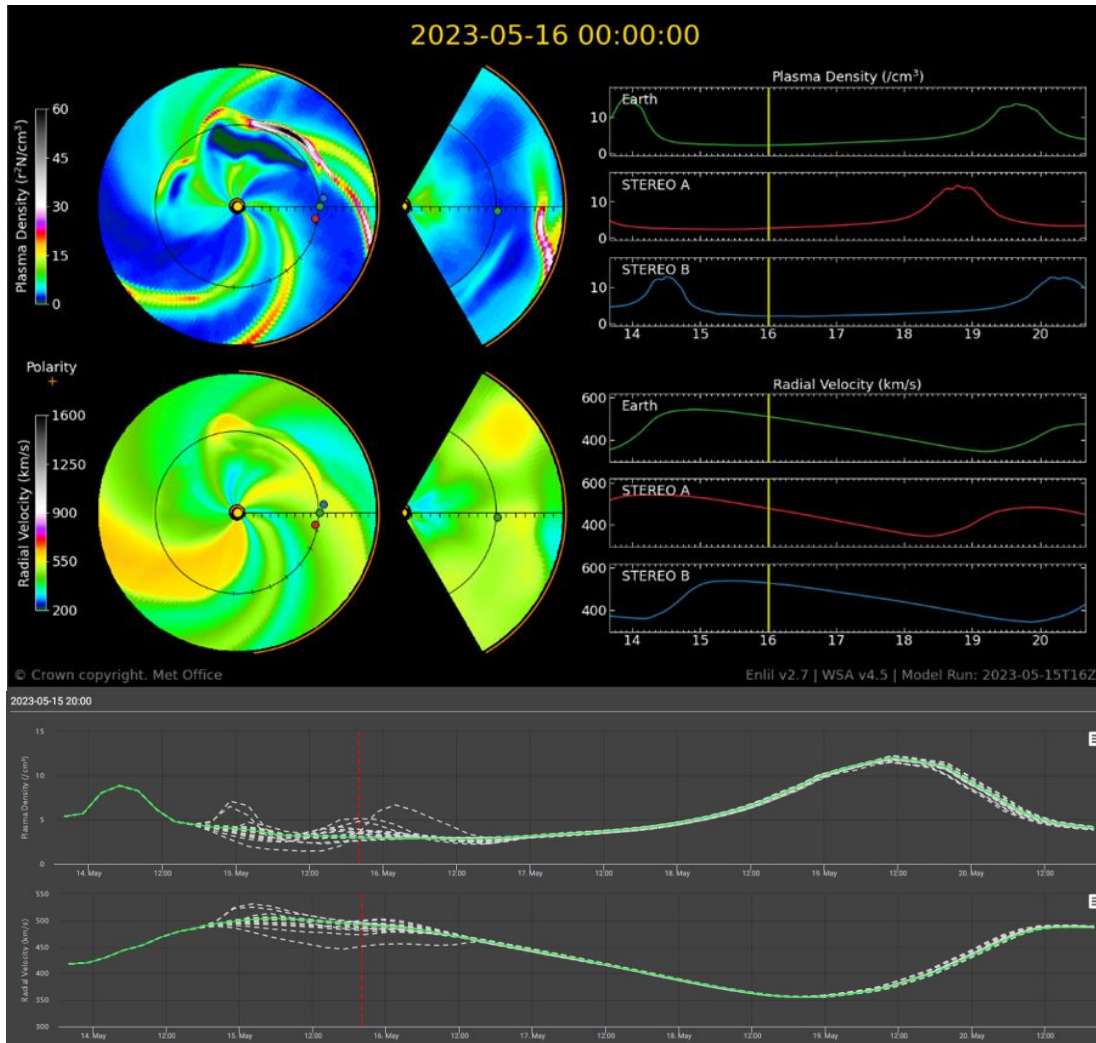
Geomagnetic activity is expected to remain generally Quiet to Unsettled, with a chance of Active intervals in the early UTC hours of day 1 (16 May) from any passing CMEs and a slight chance of an isolated G1/Minor Storm (Kp5) interval should a glancing blow arrive at Earth. Largely Quiet from Day 2 to Day 4 (16-18 May).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

Figure 2: Latest ENLIL output, including ensemble guidance, showing a possible glance from a passing CME.



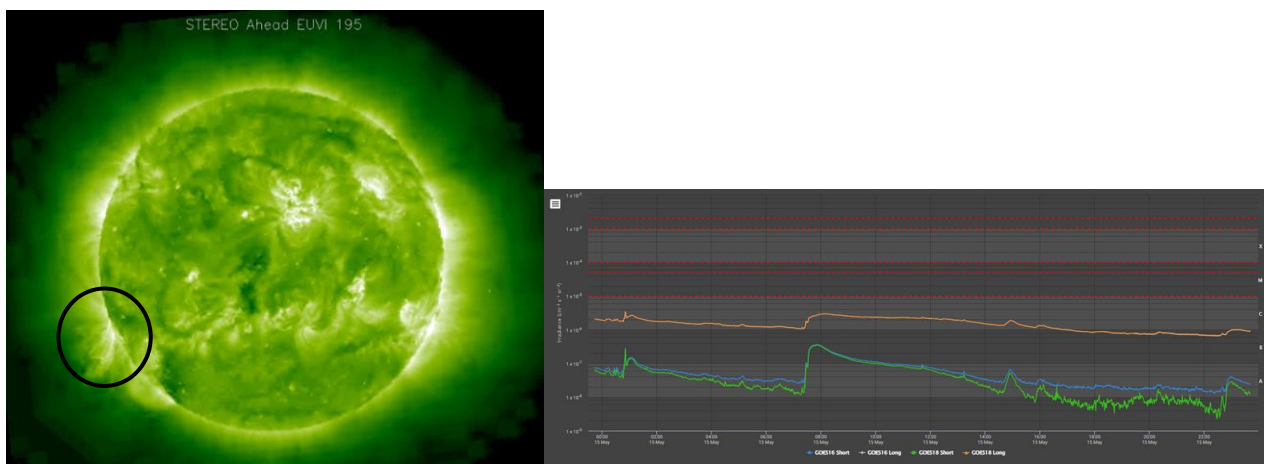
Radio Blackouts - X-Ray Flares:

There are currently six sunspot regions on the visible disc. AR3305 remains the largest and most complex group. It has become slightly more elongated, with the addition of several little specs on its trailing portion and a change of magnetic configuration. The remaining areas are relatively small and simple with little sign of change or showing signs of decay. AR3296, AR3294 and AR3297 have all now rotated off the visible disc across the western limb.

AR3296, presumed responsible for recent flare activity, has now crossed the western limb and is no longer visible. With AR3205 remaining largely inactive the likelihood of any significant flares should remain low. However a couple of CMEs have recently been observed originating from the far side, presumably from Ex-AR13288. This region should not be too far from the eastern limb and this is somewhat confirmed by the latest STEREO A EUVI 195 imagery which display a bright region over the south-eastern limb, indicating the presence of an emerging sunspot region. This region may rotate onto the visible disc on Day 2 or Day 3, increasing the overall risk of flares although this will need to be reassessed as and when this region becomes able to be analysed.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	40
Very Active	R3 to R5 X Class	No	1	1	1	5

Figure 3: STEREO A EUVI 195 showing a bright flux region emerging from the far side (left) and GOES16 X-ray flux plot over the past 24 hours (right).



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16 has remained at Background levels throughout this 24-hour period. AR3296 carries the greatest risk of a proton event. This region has rotated onto the far side but still remains capable of an S1, should a significant flare emanate from it. The risk will very gradually ease over the next couple of days.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	2	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) has ranged from Moderate to Normal Background levels over the past 24 hours, as in the previous UTC day, implying a steady state has been reached. In the absence of significant solar wind speed enhancements, electron flux and fluence levels are forecast to remain below Active throughout.

The REFM indicates a possible enhancement to the electron flux on day 2 and day 3 but this is most likely to be a reflection of what happened on the last rotation, with the arrival of a couple of CMEs on 18 and 19 April.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Latest REFM output, considered to be misleading on Day 2 & 3 (17 & 18 May)

